

CLAIMS

1. (Currently Amended) A computer-readable medium having computer-readable instructions embedded therein which, when executed by a computer, cause the computer to implement a method for facilitating determination of equilibrium values for a market system, the method for facilitating determination of equilibrium values for the market system comprising:

receiving a number of types of goods m , a number of buyers $(n + 1)$, an initial amount of each good that each buyer possesses, and a utility function for each of buyers $i=1,...,n$, for the market system;

~~receiving supply and demand data for a market system;~~

~~demarcating at least a subset of the data into buyer data and seller data;~~

applying a polynomial-time approximation method to the ~~demarcated~~ received data to generate an approximate equilibrium price vector for the market system, the polynomial-time approximation method ~~comprises~~ comprising:

initializing with an arbitrary first price vector p ;

setting a variable, D , to represent a maximum deficiency ~~[[of]]~~ for the first price vector p ;

constructing an instance, M_p , of a ~~dichotomous~~ the market system, wherein constructing the instance, M_p , of the market system comprises:

providing m types of goods and $(n + 1)$ buyers;

setting, for $i = 1,...,n$, a utility of buyer i for the goods as to be calculated from the corresponding utility function;

establishing the budget of buyers $i = 1,...,n$, according to:

$$e_i := \sum_{j=1}^m p_j w_j^i$$

wherein e_i is the budget of buyer i , p_j is the price of good j in the first price vector, and w_j^i is equal to an initial amount of good j that buyer i possesses;

setting, for $i = (n + 1)$, a utility of buyer i for each of goods $i=1,...,m$, as equal to p_j ; and

establishing the budget of buyer $i = (n + 1)$ as $e_{(n+1)} := D_i$;

executing a DPSV algorithm on the instance, M_p , starting from the first price vector p and increasing prices until equilibrium is reached, and outputting a second price vector (p') via execution of the DPSV algorithm;

setting a budget e_i' [[for i]] for ~~every agent~~ each buyer i with respect to the second price vector (p') according to:

$$e_i' := \sum_{j=1}^m p_j' w_j^i;$$

determining if a budget ratio (e_i'/e_i) for ~~every agent~~ each buyer i satisfies a budget ratio constraint of:

$$\frac{e_i'}{e_i} \leq 1 + \varepsilon,$$

wherein ε represents a desired amount of approximation;

~~outputting~~ identifying the second price vector (p') when the budget ratio constraint is satisfied for every buyer i [[,]] as the approximate equilibrium price vector for the market system; and

iterating the polynomial-time approximation method with the first price vector p set equal to the second price vector (p'), instead of an arbitrary

price vector, when the budget ratio constraint is unsatisfied, until the budget ratio constraint is satisfied;

~~sending results from the polynomial time approximation method to an iterative analysis controller component to determine if the results meet a predetermined threshold error value to halt an equilibrium modeling component; and~~

outputting the approximate equilibrium price vector ~~data~~ to a computer monitor display; and

setting prices based on the approximate equilibrium price vector.

2. (Canceled)

3. (Currently Amended) The computer-readable medium of claim 1, wherein the approximate equilibrium price vector~~[[,]]~~ comprising comprises an approximate equilibrium price vector, p^* , that produces, in conjunction with a bundle of goods~~[[, x^i ,]]~~ for each agent buyer i , an ε -approximate equilibrium for the market system such that:

for every good j :

$$(1 - \varepsilon) \sum_{i=1}^n w_j^i \leq \sum_{i=1}^n x_j^i \leq \sum_{i=1}^n w_j^i;$$

wherein x_j^i is the number of good j in the bundle of goods of buyer i ;

and for all i , a utility, $\sum_{j=1}^m u_{ij} x_j^i$ of agent buyer i is at least equal to or greater than $(1 - \varepsilon)$ times a value of an optimum solution of a maximization of the utility function~~[[, $u_i(x)$,]]~~ for the buyer i subject to:

$$[[\sum_{j=1}^m p_j^* x_j \leq \sum_{j=1}^m p_j^* w_j^i;]] \text{ (Eq. 4)}$$

$$\sum_{j=1}^m p_j^* x_j^i \leq \sum_{j=1}^m p_j^* w_j^i;$$

wherein m represents ~~types of divisible goods being traded in the market system~~ the number of types of goods and w_j^i indicates ~~[[an]]~~ the initial amount of good j that ~~agent~~ buyer i possesses.

4. (Currently Amended) The computer-readable medium of claim 1, wherein the polynomial-time approximation method ~~comprising~~ comprises an iterative method that utilizes, at least in part, revenue generated in a previous iteration for a specific ~~agent~~ buyer as a budget for the specific ~~agent~~ buyer in a current iteration.

5. (Currently Amended) The computer-readable medium of claim 4, wherein the iterative method further ~~utilizing~~ utilizes a dummy buyer to account for residual goods.

6. (Currently Amended) The computer-readable medium of claim 1, wherein the polynomial-time approximation method ~~comprising~~ comprises, at least in part, a linear utility function ~~relating to~~ for at least one ~~agent~~ buyer.

7. (Canceled)

8. (Canceled)

9. (Canceled)

10. (Canceled)

11. (Currently Amended) The computer-readable medium of claim 1, wherein the polynomial-time approximation method ~~yielding~~ yields an exact equilibrium price for the market system.

12. (Currently Amended) A computer-implemented method for facilitating determination of equilibrium values for a market system, comprising:

receiving, by a computing system, a number of types of goods m , a number of buyers $(n + 1)$, an initial amount of each good that each buyer possesses, and a utility function for each of buyers $i = 1, \dots, n$, for the market system;

~~receiving supply and demand data for a market system via a computer processor;~~

~~demarcating at least a subset of the data into buyer data and seller data;~~

applying, by the computing system, a polynomial-time approximation method to the ~~demarcated~~ received data to generate an approximate equilibrium price vector for the market system, the polynomial-time approximation method ~~comprises~~ comprising:

initializing with an arbitrary first price vector \underline{p} ;

setting a variable, D , to represent a maximum deficiency ~~[[of]]~~ for the first price vector \underline{p} ;

constructing an instance, $M_{\underline{p}}$, of ~~[[a]]~~ the ~~dichotomous~~ market system, wherein constructing the instance, $M_{\underline{p}}$, of the market system comprises:

providing m types of goods and $(n + 1)$ buyers;

setting, for $i = 1, \dots, n$, a utility of buyer i for the goods as to be calculated from the corresponding utility function;

establishing the budget of buyers $i = 1, \dots, n$, according to:

$$e_i := \sum_{j=1}^m p_j w_j^i,$$

wherein e_i is the budget of buyer i , p_j is the price of good j in the first price vector, and w_j^i is equal to an initial amount of good j that buyer i possesses;

setting, for $i = (n + 1)$, a utility of buyer i for each of goods $j = 1, \dots, m$, as equal to p_j ; and

establishing the budget of buyer $i = (n + 1)$ as $e_{(n+1)} := D$;

executing a DPSV algorithm on the instance, M_p , starting from the first price vector p and increasing prices until equilibrium is reached, and outputting a second price vector (p');

setting a budget e_i' ~~[[for i]]~~ for ~~every agent~~ each buyer i with respect to the second price vector (p') according to:

$$e_i' := \sum_{j=1}^m p_j' w_j^i;$$

determining if a budget ratio (e_i'/e_i) for ~~every agent~~ each buyer i satisfies a budget ratio constraint of:

$$\frac{e_i'}{e_i} \leq 1 + \varepsilon,$$

wherein ε represents a desired amount of approximation;

~~outputting~~ identifying the second price vector (p') when the budget ratio constraint is satisfied for every buyer i $[[.,.]$ as the approximate equilibrium price vector for the market system; and

iterating the polynomial-time approximation method with the first price vector p set equal to the second price vector (p'), instead of an arbitrary price vector, when the budget ratio constraint is unsatisfied, until the budget ratio constraint is satisfied;

~~sending results from the polynomial-time approximation method to an iterative analysis controller component to determine if the results meet a predetermined threshold error value to halt an equilibrium modeling component; and~~

outputting the approximate equilibrium price vector data to a computer monitor display; and

setting prices based on the approximate equilibrium price vector.

13. (Canceled)

14. (Currently Amended) The computer-implemented method for facilitating determination of equilibrium values for the market system of claim 12, wherein the approximate equilibrium price vector $[[.,.]$ ~~comprising~~ comprises an approximate equilibrium price vector, p^* , that produces, in conjunction with a bundle of goods $[[.,x^j]]$ for each agent buyer i , an ε -approximate equilibrium for the market system such that:

for every good j :

$$(1 - \varepsilon) \sum_{i=1}^n w_j^i \leq \sum_{i=1}^n x_j^i \leq \sum_{i=1}^n w_j^i;$$

wherein x_j^i is the number of good j in the bundle of goods of buyer i ; and for all i , a utility, $\sum_{j=1}^m u_{ij} x_j^i$, of agent buyer i is at least equal to or greater than $(1-\varepsilon)$ times a value of an optimum solution of a maximization of the utility function $[[u_i(x),]]$ for the buyer i subject to:

$$[[\sum_{j=1}^m p_j^* x_j \leq \sum_{j=1}^m p_j^* w_j^i;]] \text{ (Eq. 4)}$$

$$\sum_{j=1}^m p_j^* x_j^i \leq \sum_{j=1}^m p_j^* w_j^i;$$

wherein m represents ~~types of divisible goods being traded in the market system~~ the number of types of goods and w_j^i indicates ~~[[an]]~~ the initial amount of good j that agent buyer i possesses.

15. (Currently Amended) The computer-implemented method for facilitating determination of equilibrium values for the market system of claim 12, wherein the polynomial-time approximation method ~~comprising~~ comprises an iterative method that utilizes, at least in part, revenue generated in a previous iteration for a specific agent buyer as a budget for the specific agent buyer in a current iteration.

16. (Currently Amended) The computer-implemented method for facilitating determination of equilibrium values for the market system of claim 15, wherein the iterative method further ~~utilizing~~ utilizes a dummy buyer to account for residual goods.

17. (Canceled)

18. (Canceled)
19. (Canceled)
20. (Currently Amended) The computer-implemented method for facilitating determination of equilibrium values for the market system of claim 12, wherein the polynomial-time approximation method yielding yields an exact equilibrium price for the market system.
21. (Canceled)
22. (Canceled)
23. (Currently Amended) A computer system that facilitates determination of equilibrium values for a market system, comprising:
- a processor; and
- a memory connected to the processor;
- wherein the processor and the memory perform the steps of:
- receiving a number of types of goods m , a number of buyers $(n + 1)$,
- an initial amount of each good that each buyer possesses, and a utility
- function for each of buyers $i = 1, \dots, n$, for the market system;
- ~~means for receiving supply and demand data for a market system,~~
- ~~and demarcating at least a subset of the data into buyer data and seller data;~~

~~means for~~ applying a polynomial-time approximation method to the ~~demarcated~~ received data to generate an approximate[[d]] equilibrium price vector for the market system, the polynomial-time approximation method ~~comprises~~ comprising:

initializing with an arbitrary first price vector p ;

setting a variable, D , to represent a maximum deficiency [[of]] for the first price vector p ;

constructing an instance, M_p , of [[a]] the dichotomous market system, wherein constructing the instance. M_p of the market system comprises:

providing m types of goods and $(n + 1)$ buyers;

setting, for $i = 1, \dots, n$, a utility of buyer i for the goods as to be calculated from the corresponding utility function;

establishing the budget of buyers $i = 1, \dots, n$, according to:

$$e_i := \sum_{j=1}^m p_j w_j^i,$$

wherein e_i is the budget of buyer i , p_j is the price of good j in the first price vector, and w_j^i is equal to an initial amount of good j that buyer i possesses;

setting, for $i = (n + 1)$, a utility of buyer i for each of goods $j=1, \dots, m$, as equal to p_j ; and

establishing the budget of buyer $i = (n + 1)$ as $e_{(n+1)} := D$;

executing a DPSV algorithm on the instance, M_p , starting from the first price vector p and increasing prices until equilibrium is reached, and outputting a second price vector (p');

setting a budget e_i' for ~~every agent~~ each buyer i with respect to the second price vector (p') according to:

$$e_i' := \sum_{j=1}^m p_j' w_j^i;$$

determining if a budget ratio (e_i'/e_i) for ~~every agent~~ each buyer i satisfies a budget ratio constraint of:

$$\frac{e_i'}{e_i} \leq 1 + \varepsilon,$$

wherein ε represents a desired amount of approximation;

~~outputting~~ identifying the second price vector (p') when the budget ratio constraint is satisfied for every buyer i ~~[[,]]~~ as the approximate equilibrium price vector for the market system; and

iterating the polynomial-time approximation method with the first price vector p set equal to the second price vector (p') , instead of an arbitrary price vector, when the budget ratio constraint is unsatisfied, until the budget ratio constraint is satisfied;

~~means for sending results from the polynomial time approximation method to an iterative analysis controller component to determine if the results meet a predetermined threshold error value to halt an equilibrium modeling component; and~~

~~means for outputting the approximate equilibrium price vector data to a computer monitor display; and~~

setting prices based on the approximate equilibrium price vector.

24. (Canceled)

25. (Currently Amended) The computer system of claim 23, wherein the polynomial-time approximation method ~~comprising~~ comprises an iterative method that utilizes, at least in part, revenue generated in a previous iteration for a specific ~~agent~~ buyer as a budget for the specific ~~agent~~ buyer in a current iteration.

26. (Currently Amended) The computer system of claim 23, wherein the polynomial-time approximation method ~~employing, at least in part, a dichotomous market solution algorithm to provide at least one price selected from the group consisting of an approximate market equilibrium price and~~ yields an exact equilibrium market price for the market system.

27. (Canceled)

28. (Canceled)

29. (Canceled)

30. (Canceled)